Cheap DECAF: Density Estimation for Cetaceans from Acoustic Fixed Sensors Using Separate, Non-Linked Devices

David K. Mellinger
Cooperative Institute for Marine Resources Studies
Oregon State University
2030 SE Marine Science Dr.
Newport, OR 97330
phone: (541) 867-0372 fax: (541) 867-3907 email: David.Mellinger@oregonstate.edu

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LONG-TERM GOALS

Several of the current methods for density estimation of cetaceans using passive fixed acoustics rely on large, dense arrays of cabled hydrophones and/or auxiliary information from animal tagging projects conducted at the same time as the acoustic survey. Obtaining such data is costly, and may be impractical to the wider community interested in estimating cetacean density. Therefore, the goal of Cheap DECAF is to focus on the development of cetacean density estimation methods using sensors that are sparsely distributed and less expensive to deploy than the cabled military arrays focussed on to date.

OBJECTIVES

Recordings of fin whale (*Balaenoptera physalus*) from a sparse array of ocean bottom seismometers (OBSs) will be the dataset used to develop and test a variety of density estimation methods. The OBS array, comprising 24 instruments, was deployed for one year (2007-2008) off the south coast of Portugal, near the Straits of Gibraltar (Fig. 1).

The specific objectives of the project are to:

1. demonstrate how cue-counting methods can be used efficiently to obtain estimates of density over long time periods and large spatial scales using directional sound sensors;
2. extend the methods to allow for uncertainty in the depth of vocalizing animals;
3. develop and apply methods based on tracking moving individual animals;
4. develop and apply methods based on measuring total sound energy in relevant frequency bands; and
5. obtain baseline estimates of spatial density of fin whales in the study area.

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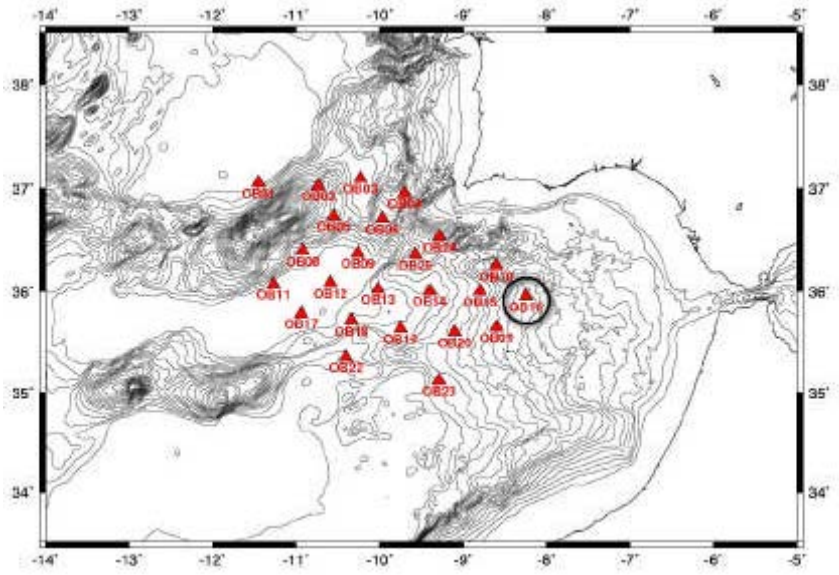

Fig. 1. Location of the array of 24 OBS sensors in the Atlantic off Portugal.

APPROACH

This project is in collaboration with the University of St. Andrews (grant number: N00014-11-1-0615, PI: Len Thomas). The work is divided into three components, as follows:

Component 1: Fin whale vocalizations will be automatically detected and localized across the 1-year dataset, using existing methods. Established distance sampling methods using cue counting will be used to generate seasonal density estimates, and spatial patterns in density will be related to oceanographic features. Customized distance sampling software will be used (Thomas *et al*., 2010). This component will also include the development of methods to account for the depth distribution of animals, which will involve a simulation exercise.

Component 2: This component will focus on estimating density where the unit of interest is the individual animal – rather than a cue, i.e., a vocalization. Methods to account for the movement of individual animals will be developed via a simulation study, building on work completed for a Master's thesis (DiTraglia, 2007).

Component 3: This component will develop a method that uses the total energy present in a species' frequency band as the statistic upon which a density estimate is made. The approach used will involve a Monte Carlo simulation and propagation modeling, to link density of animals to a given received energy level (Mellinger et al. 2009).

Component 3 is being led by Oregon State University, and Components 1 and 2 are being led by St. Andrews. There is also a project management element, coordinating bi-monthly conference-call progress meetings, and at least two face-to-face meetings, one in each project year.

WORK COMPLETED

This project was due to start in April 2011, but this was delayed until September 2011 to allow the named post-doctoral research fellow on the St. Andrews component, Danielle Harris, to complete her PhD.

RESULTS

No results to date.

IMPACT/APPLICATIONS

The main aim of Cheap DECAF is to make density estimation of cetaceans less costly and, therefore, more accessible to the wider scientific community. The methods developed here will be applicable to re-deployable arrays of both sea-bed mounted instruments (such as the OBS array) and surface buoys, so will hopefully increase our capability to monitor cetacean density in geographic areas of interest, including those where naval operations are conducted.

RELATED PROJECTS

Cheap DECAF (Grant number: N00014-1-11-0615; PI: Len Thomas, University of St. Andrews)

DECAF: Density Estimation for Cetaceans from passive Acoustic Fixed sensors (ended February 2011)

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